CLAIMS

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1. A computer-implemented method for use in creating a digital model of an individual component of a patient's dentition, the method comprising:
   (a) receiving a data set that forms a three-dimensional (3D) representation of the patient's dentition;
   (b) applying a computer-implemented test to the data set to identify data elements that represent portions of an individual component of the patient's dentition; and
   (c) creating a digital model of the individual component based upon the identified data elements.

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2. The method of claim 1, wherein the data set includes data taken from at least one of the following sources: two-dimensional (2D) x-ray data and three-dimensional (3D) x-ray data.

3. The method of claim 1, wherein the data set includes data taken from at least one of the following sources: computed tomography (CT) scan data and magnetic resonance imaging (MRI) scan data.

4. The method of claim 1, wherein the data set includes data taken from a photographic image of the patient's dentition.

5. The method of claim 1, wherein some of the data is obtained by imaging a physical model of the patient's teeth.

6. The method of claim 1, wherein some of the data is obtained by imaging the patient's teeth directly.

7. The method of claim 1, wherein the data set forms a 3D volumetric representation of the

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patient's dentition.

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8. The method of claim 1, wherein the data set includes geometric surface data that forms a 3D geometric surface model of the patient's dentition.

9. The method of claim 1, wherein the individual component is an individual tooth in the patient's dentition.

10. The method of claim 1, wherein the individual component includes gum tissue found in the patient's dentition.

11. The method of claim 1, wherein applying the computer-implemented test includes receiving information input by a human user to identify a boundary of the individual component to be modeled.

12. The method of claim 11, wherein receiving information includes receiving position data from a computer-implemented tool through which the human user identifies the boundary in a graphical representation of the patient's dentition.

13. The method of claim 12, wherein the computer-implemented tool is a saw tool that allows the user to identify the boundary by defining a curve in the graphical representation that separates the data elements associated with the individual component from other elements of the data set.

14. The method of claim 12, wherein the computer-implemented tool is an eraser tool that allows the user to identify the boundary by erasing a portion of the graphical representation representing the boundary.

15. The method of claim 1, wherein receiving the data, applying the computer-implemented test, and creating the electronic model all are carried out by a computer without human intervention.

16. The method of claim 1, wherein applying the computer-implemented test includes automatically applying a rule to identify a boundary of the individual component to be modeled.

17. The method of claim 16, wherein the boundary includes a surface of a tooth.

18. The method of claim 16, wherein the boundary includes a gingival margin.

19. The method of claim 1, wherein applying the computer-implemented test includes identifying elements of the data set that represent a structural core of the individual component to be modeled and labeling those data elements as belonging to the individual component.

20. The method of claim 19, wherein the individual component to be modeled includes an individual tooth and the structural core approximately coincides with neurological roots of the tooth.

21. The method of claim 19, wherein applying the computer-implemented test includes applying a test to link other data elements to those representing the structural core and labeling the linked data elements as belonging to the individual component.

22. The method of claim 21, wherein applying the test to link other data elements to those representing the structural core includes assigning a distance measure to each element of the data set, where the distance measure indicates a measured distance between a reference point in the dentition and the portion of the dentition represented by the data element to

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which the distance measure is assigned.

23. The method of claim 22, wherein applying the test to link other data elements includes linking a data element to the structural core if the assigned distance measure is less than the distance measure assigned to a data element representing a portion of the structural core.

24. The method of claim 22, wherein the reference point lies on a tooth surface.

25. The method of claim 21, wherein applying the test to link other data elements to the structural core includes applying a test to determine whether a data element lies outside of the dentition and, if so, labeling the data element as a background element.

26. The method of claim 25, wherein applying the test to determine whether the data element lies outside of the dentition includes comparing an image value associated with the data element to a threshold value.

27. The method of claim 19, further comprising applying another computer-implemented test to identify elements of the data set that represent a structural core of another individual component of the dentition and labeling those data elements as belonging to the other individual component.

28. The method of claim 27, wherein applying the computer-implemented tests includes applying tests to link other elements of the data set to those representing the structural cores of the individual components and labeling the linked elements as belonging to the individual components to which they are linked.

29. The method of claim 28, wherein applying the tests to link other data elements to the structural cores of the individual components includes determining whether a data element already is labeled as belonging to one of the individual components.

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30. The method of claim 1, wherein applying the computer implemented test includes identifying an initial 2D cross-section of the individual component having continuous latitudinal width, a relative minimum value of which occurs at an end of the initial cross-section.

31. The method of claim 30, wherein applying the computer-implemented test includes isolating portions of the data corresponding to the initial 2D cross-section of the individual component to be modeled.

32. The method of claim 31, wherein the received data includes 3D image data obtained by imaging the individual component volumetrically, and wherein isolating portions of the data corresponding to the initial 2D cross-section includes isolating elements of the 3D image data representing the initial 2D cross-section.

33. The method of claim 30, wherein applying the computer-implemented test includes applying a test to identify the end of the initial cross-section at which the relative minimum value of the latitudinal width occurs.

34. The method of claim 33, wherein applying the test to identify the end of the initial cross-section includes:

(a) establishing line segments within the initial cross-section, each of which is bounded at each end by an endpoint lying on a surface of the individual component, and each of which is roughly perpendicular to a latitudinal axis of the individual component;
(b) calculating a length for each line segment; and
(c) identifying elements of the data set that correspond to the endpoints of the line segment with the shortest length.

35. The method of claim 34, wherein applying the computer-implemented test also includes:

(a) isolating portions of the data set corresponding to other 2D cross-sections of the individual component, all lying in planes parallel to the initial 2D cross-section;

(b) for each of the other cross-sections, identifying data elements that correspond to endpoints of a line segment representing an end of the cross-section; and

(c) defining a solid surface that contains all of the identified data elements.

36. The method of claim 35, further comprising labeling the solid surface as representing a surface of the individual component to be modeled.

37. The method of claim 35, further comprising using the data elements identified in the initial cross-section as guides for identifying the data elements in the other cross-sections.

38. The method of claim 34, wherein applying the test to identify the end of the initial cross-section includes first creating an initial curve that is roughly perpendicular to the latitudinal axis of the individual component and that is fitted between the surfaces of the 2D cross-section on which the endpoints of the line segments will lie.

39. The method of claim 38, wherein establishing the line segments includes first establishing a set of initial line segments that are roughly perpendicular to the curve and to the latitudinal axis and that have endpoints lying on the surfaces of the individual component.

40. The method of claim 39, wherein establishing the line segments also includes pivoting each initial line segment about a point at which the initial line segment intersects the curve until the initial line segment has its shortest possible length.

41. The method of claim 40, wherein establishing the line segments also includes:

(a) locating a midpoint for each of the initial line segments after pivoting; and

(b) creating a refined curve that passes through all of the midpoints.

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43. The method of claim 38, wherein the individual component is a tooth and the curve is a portion of a larger curve fitted among the lingual and buccal surfaces of all teeth in a 2D cross-section of a tooth arch in which the tooth lies.

44. The method of claim 43, wherein the larger curve is a catenary.

45. The method of claim 43, wherein the larger curve is created by manipulating mathematical control points to fit the curve to the shape of the cross-section of the tooth arch.

46. The method of claim 34, wherein establishing the line segments includes first establishing an initial line segment by creating a line that intersects the initial 2D cross-section, such that the initial line segment has endpoints that lie on surfaces of the individual component.

47. The method of claim 46, wherein establishing the line segments also includes establishing at least one additional line segment parallel to and spaced a predetermined distance from a previously established line segment.

48. The method of claim 47, wherein establishing the line segments also includes, for each additional line segment, locating a midpoint of the additional line segment and pivoting the additional line segment about the midpoint until the additional line segment has its shortest possible length.

49. The method of claim 48, wherein establishing the line segments also includes limiting the rotation of each additional line segment to no more than a predetermined amount.

50. The method of claim 49, wherein the rotation of each additional line segment is limited to

no more than approximately +/- 10°.

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51. The method of claim 48, wherein establishing the line segments also includes establishing a curve that is fitted among the midpoints of the additional line segments.

52. The method of claim 51, wherein establishing the line segments includes establishing the line segments to be perpendicular to the curve.

53. The method of claim 52, wherein establishing the line segments includes locating midpoints for each of the line segments and pivoting each line segment about its midpoint until the line segment has its shortest possible length.

54. The method of claim 30, wherein the individual component is a tooth and the relative minimum value of the initial 2D cross-section lies on an interproximal surface of the tooth.

55. The method of claim 54, wherein identifying the initial 2D cross-section includes isolating elements of the data set that correspond to 2D cross-sections of the tooth lying in parallel planes between the roots and the occlusal surface of the tooth.

56. The method of claim 55, wherein identifying the initial 2D cross-section also includes identifying adjacent ones of the 2D cross-sections in which the interproximal surface of the tooth is obscured by gum tissue in one of the adjacent cross-sections and is not obscured by gum tissue in the other adjacent cross-section.

57. The method of claim 56, wherein identifying the initial 2D cross-section also includes selecting as the initial 2D cross-section the adjacent cross-section in which the interproximal surface of the tooth is not obscured by gum tissue.

58. The method of claim 55, wherein identifying the initial 2D cross-section also includes, for

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each of the isolated cross-sections, establishing a contour line that outlines the shape of the dentition in that cross-section.

59. The method of claim 58, wherein identifying the initial 2D cross-section also includes applying a test to each of the isolated cross-sections to identify those cross-sections in which the interproximal surface of the tooth is not obscured by gum tissue.

60. The method of claim 59, wherein applying the test includes calculating the rate of curvature of the contour line.

61. The method of claim 59, wherein identifying the initial 2D cross-section includes selecting as the initial 2D cross-section the isolated cross-section that lies closest to the roots of the tooth and in which the interproximal surface of the tooth is not obscured by gum tissue.

62. The method of claim 30, wherein applying the computer-implemented test also includes identifying two elements of the data set that define endpoints of a line segment spanning the relative minimum width of the initial 2D cross-section.

63. The method of claim 62, wherein applying the computer-implemented test also includes defining, for each endpoint, a neighborhood containing a predetermined number of elements of the data set near the endpoint in the initial 2D cross-section.

64. The method of claim 63, wherein applying the computer-implemented test also includes identifying an additional 2D cross-section of the individual component in a plane parallel and adjacent to the initial 2D cross-section, where the additional 2D cross-section also has a continuous, latitudinal width with a relative minimum value occurring at one end of the cross-section.

65. The method of claim 64, wherein applying the computer-implemented test also includes

identifying two elements of the data set that define endpoints of a line segment spanning the relative minimum width of the additional 2D cross-section by:

(a) defining two neighborhoods of data elements, each containing elements of the data set that are adjacent to the data elements contained in the neighborhoods defined for the initial 2D cross-section; and

(b) identifying one data element in each neighborhood that corresponds to one of the endpoints of the line segment spanning the relative minimum width of the additional 2D cross-section.

66. The method of claim 65, further comprising establishing a solid surface that is fitted among line segments spanning the relative minimum widths of the parallel 2D cross-sections.

67. The method of claim 66, wherein the individual component to be modeled is a tooth and the solid surface represents an interproximal surface of the tooth.

68. The method of claim 30, further comprising receiving information provided by a human user that identifies elements of the data set that correspond to the relative minimum width of the initial 2D cross-section.

69. The method of claim 68, further comprising displaying a graphical representation of the patient's dentition in which the user identifies portions corresponding to the relative minimum width of the cross-section.

70. The method of claim 69, wherein the graphical representation is three dimensional.

71. The method of claim 69, wherein the graphical representation includes a 2D representation of the initial 2D cross-section.

72. The method of claim 71, further comprising receiving the information from an input device

used by the human user to identify the relative minimum width of the initial 2D cross-section in the graphical representation.

73. The method of claim 71, wherein the initial 2D cross-section is one of many 2D cross-sections displayed to the human user.

74. The method of claim 71, further comprising receiving information from the human user identifying which of the displayed 2D cross-sections is the initial 2D cross-section.

75. A computer-implemented method for use in creating a digital model of a tooth in a patient's dentition, the method comprising:

(a) receiving a three-dimensional (3D) data set representing the patient's dentition;

(b) applying a computer-implemented test to identify data elements that represent an interproximal margin between two teeth in the dentition;

(c) applying another computer-implemented test to select data elements that lie on one side of the interproximal margin for inclusion in the digital model.

76. The method of claim 75, further comprising creating a set of 2D planes that intersect the dentition roughly perpendicular to an occlusal plane of the dentition, each 2D plane including data elements that form a 2D cross-section of the dentition.

77. The method of claim 76, further comprising identifying the 2D plane with the smallest cross-sectional area.

78. The method of claim 77, further comprising rotating the 2D plane with the smallest cross-sectional area to at least one other orientation to form at least one other 2D cross-section of the dentition.

79. The method of claim 78, further comprising selecting the orientation that gives the rotated

plane its smallest possible cross-sectional area.

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80. The method of claim 79, further comprising identifying data elements that represent the selected orientation of the rotated plane as lying on an interproximal margin.

81. The method of claim 78, wherein the plane is rotated about two orthogonal lines passing through its center point.

82. The method of claim 77, further comprising creating a set of additional 2D planes in the vicinity of the 2D plane with the smallest cross-sectional area.

83. The method of claim 82, further comprising identifying the plane in the set of additional planes that has the smallest cross-sectional area.

84. The method of claim 83, further comprising rotating the plane with the smallest cross-sectional area to at least one other orientation to form at least one other 2D cross-section of the dentition.

85. The method of claim 84, further comprising selecting the orientation that produces the 2D cross-section with the smallest possible area.

86. The method of claim 76, wherein creating a set of 2D planes includes creating an initial plane near one end of the dentition.

87. The method of claim 86, further comprising selecting a point in the dentition that is a predetermined distance from the initial plane and creating a second plane.

88. The method of claim 87, wherein the second plane is roughly parallel to the initial plane.

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89. The method of claim 87, further comprising rotating the second plane to at least one additional orientation to form at least one additional 2D cross-section of the dentition.

90. The method of claim 89, further comprising selecting the orientation that produces the 2D cross-section with the smallest cross-sectional area.

91. The method of claim 89, further comprising selecting a point that is a predetermined distance from the second plane and creating a third plane that includes the selected point.

92. The method of claim 91, further comprising rotating the third plane to at least one other orientation to create at least one additional 2D cross-section of the dentition.

93. The method of claim 91, further comprising creating additional planes, each including a point that is a predetermined distance from a preceding plane, until the other end of the dentition is reached.

94. The method of claim 93, further comprising identifying at least one plane having a local minimum in cross-sectional area.

95. The method of claim 93, further comprising identifying a centerpoint of the cross-section in each of the planes and creating a curve that fits among the identified centerpoints.

96. The method of claim 95, further comprising creating a set of additional 2D planes along the curve, where the curve is roughly normal to each of the additional planes, and where each of the additional planes is roughly perpendicular to the occlusal plane.

97. The method of claim 96, further comprising identifying at least one of the additional planes that has a local minimum in cross-sectional area.

Sub B3 98. A computer-implemented method for use in creating a digital model of a tooth in a patient's dentition, the method comprising:

(a) receiving a 3D dataset representing at least a portion of the patient's dentition, including at least a portion of a tooth and gum tissue surrounding the tooth;

(b) applying a test to identify data elements lying on a gingival boundary that occurs where the tooth and the gum tissue meet; and

(c) applying a test to the data elements lying on the boundary to identify other data elements representing portions of the tooth.

Sub C10 99. The method of claim 98, wherein applying the test to identify data elements on the gingival boundary includes creating an initial 2D plane that intersects the dentition roughly perpendicular to an occlusal plane of the dentition and that includes data elements representing an initial cross-sectional surface of the dentition.

100. The method of claim 99, wherein applying the test includes locating a cusp in the initial cross-sectional surface.

101. The method of claim 100, wherein locating the cusp includes calculating rate of curvature of the initial cross-sectional area at selected points on the cross-sectional surface.

102. The method of claim 101, wherein locating the cusp includes identifying the point at which the rate of curvature is greatest.

103. The method of claim 100, wherein applying the test includes creating a second 2D plane that is roughly parallel to the initial 2D plane and that includes data elements representing a second cross-sectional surface of the dentition.

104. The method of claim 103, wherein applying the test includes locating a cusp in the second cross-sectional surface.

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105. The method of claim 104, wherein locating the cusp in the second cross-sectional surface includes defining a neighborhood of data elements around the cusp in the initial cross-sectional surface and projecting the neighborhood onto the second cross-sectional surface.

106. The method of claim 105, wherein locating the cusp in the second cross-sectional surface includes searching for the cusp only within the neighborhood projected onto the second cross-sectional surface.

107. The method of claim 99, wherein applying the test includes locating two cusps in the initial cross-sectional surface.

108. The method of claim 107, wherein applying the test includes creating a second 2D plane that is roughly parallel to the initial 2D plane and that includes data elements representing a second cross-sectional surface of the dentition.

109. The method of claim 108, wherein applying the test includes locating two cusps in the second cross-sectional surface.

110. The method of claim 109, wherein locating the cusps in the second cross-sectional surface includes defining two neighborhoods of data elements around the two cusps in the initial cross-sectional surface and projecting the neighborhoods onto the second cross-sectional surface.

111. The method of claim 110, wherein each neighborhood projected onto the second cross-sectional surface includes data elements representing portions of the tooth and data elements representing the gum tissue surrounding the tooth.

112. The method of claim 111, wherein the data elements representing the tooth include voxels

of one color and the data elements representing the gum tissue include voxels of another color.

113. The method of claim 111, wherein locating the cusps in the second cross-sectional surface includes locating the pair of data elements representing gum tissue that lie closest together, where each of the two neighborhoods projected onto the second cross-sectional surface includes one of the data elements in the pair.

114. The method of claim 98, wherein applying the test to identify data elements on the gingival boundary includes creating a series of roughly parallel 2D planes, each intersecting the dentition roughly perpendicular to an occlusal plane of the dentition, and each including data elements that represent a cross-sectional surface of the dentition.

115. The method of claim 114, wherein the cross-sectional surface in each 2D plane includes two cusps that roughly identify the locations of the gingival boundary.

116. The method of claim 115, wherein applying the test includes identifying the cusps in each cross-sectional surface.

117. The method of claim 116, wherein identifying the cusps includes locating the cusps in one of the planes and then confining the search for cusps in an adjacent plane to a predetermined area in the vicinity of the identified cusps.

118. The method of claim 115, further comprising allowing a human user to select data elements that roughly identify the locations of the cusps in a selected one of the cross-sectional areas.

119. The method of claim 118, further comprising searching for cusps in the selected cross-sectional area and confining the search to data elements lying within a predetermined area in the vicinity of the data elements selected by the human user.

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120. The method of claim 118, further comprising searching for cusps in an adjacent cross-sectional area and confining the search to data elements lying within a predetermined area in the vicinity of the data elements selected by the human user.

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121. A computer program, stored on a tangible storage medium, for use in creating a digital model of an individual component of a patient's dentition, the program including executable instructions that, when executed by a computer, cause the computer to:

(a) receive a data set that forms a three-dimensional (3D) representation of the patient's dentition;

(b) apply a test to the data set to identify data elements that represent portions of an individual component of the patient's dentition; and

(c) create a digital model of the individual component based upon the identified data elements.

122. The program of claim 121, wherein the computer receives the data, applies the test, and creates the electronic model without human intervention.

123. The program of claim 121, wherein the computer, in applying the test, applies a rule to identify a boundary of the individual component to be modeled.

124. The program of claim 121, wherein the computer, in applying the test, identifies elements of the data set that represent a structural core of the individual component to be modeled and labels those data elements as belonging to the individual component.

125. The program of claim 124, wherein the computer, in applying the test, links other data elements to those representing the structural core and labels the linked data elements as belonging to the individual component.

126. The program of claim 125, wherein the computer, in applying the test:

(a) assigns a distance measure to each element of the data set, where the distance measure indicates a measured distance between a reference point in the dentition and the portion of the dentition represented by the data element to which the distance measure is assigned; and

(b) links a data element to the structural core if the assigned distance measure is less than the distance measure assigned to a data element representing a portion of the structural core.

127. The program of claim 121, wherein the computer, in applying the test, identifies an initial 2D cross-section of the individual component having continuous latitudinal width, a relative minimum value of which occurs at an end of the initial cross-section.

128. The program of claim 127, wherein the computer, in applying the test, identifies the end of the initial cross-section at which the relative minimum value of the latitudinal width occurs by:

(a) establishing line segments within the initial cross-section, each of which is bounded at each end by an endpoint lying on a surface of the individual component, and each of which is roughly perpendicular to a latitudinal axis of the individual component;

(b) calculating a length for each line segment; and

(c) identifying elements of the data set that correspond to the endpoints of the line segment with the shortest length.

129. The program of claim 128, wherein the computer, in applying the test:

(a) isolates portions of the data set corresponding to other 2D cross-sections of the individual component, all lying in planes parallel to the initial 2D cross-section;

(b) for each of the other cross-sections, identifies data elements that correspond to endpoints of a line segment representing an end of the cross-section; and

(c) defines a solid surface that contains all of the identified data elements.

130. The program of claim 128, wherein the computer, in applying the test:

(a) first creates an initial curve that is roughly perpendicular to the latitudinal axis of the individual component and that is fitted between the surfaces of the 2D cross-section on which the endpoints of the line segments lie;

(b) establishes a set of initial line segments that are roughly perpendicular to the curve and to the latitudinal axis and that have endpoints lying on the surfaces of the individual component;

(c) pivots each initial line segment about a point at which the initial line segment intersects the curve until the initial line segment has its shortest possible length;

(d) locates a midpoint for each of the initial line segments after pivoting; and

(e) creates a refined curve that passes through all of the midpoints and that is roughly normal to all of the line segments.

131. The program of claim 128, wherein the computer, in applying the test, also:

(a) establishes an initial line segment by creating a line that intersects the initial 2D cross-section, such that the initial line segment is bounded by endpoints that lie on surfaces of the individual component;

(b) establishes at least one additional line segment parallel to and spaced a predetermined distance from a previously established line segment; and

(c) for each additional line segment, locates a midpoint of the additional line segment and pivots the additional line segment about the midpoint until the additional line segment has its shortest possible length.

132. The program of claim 131, wherein the computer, in applying the test, also:

(a) establishes a curve that is fitted among the midpoints of the additional line segments;

(b) establishes a new set of line segments that are perpendicular to the curve;

(c) locates midpoints for each of the line segments in the new set; and

(d) pivots each line segment in the new set about its midpoint until the line segment has its shortest possible length.

133. The program of claim 127, wherein the individual component is a tooth and the relative minimum value of the initial 2D cross-section lies on an interproximal surface of the tooth.

134. The program of claim 133, wherein the computer, in identifying the initial 2D cross-section, isolates elements of the data set that correspond to 2D cross-sections of the tooth lying in parallel planes between the roots and the occlusal surface of the tooth.

135. The program of claim 134, wherein the computer, in identifying the initial 2D cross-section, identifies adjacent ones of the 2D cross-sections in which the interproximal surface of the tooth is obscured by gum ~~tissue in~~ one of the adjacent cross-sections and is not obscured by gum tissue in the other adjacent cross-section.

136. The program of claim 135, wherein the computer, in identifying the initial 2D cross-section, selects as the initial 2D cross-section the adjacent cross-section in which the interproximal surface of the tooth is not obscured by gum tissue.

137. The program of claim 134, wherein the computer, ~~in identifying~~ the initial 2D cross-section, identifies for each of the isolated cross-sections a contour line that outlines the shape of the dentition in that cross-section.

138. The program of claim 137, wherein the computer, in identifying the initial 2D cross-section, applies a test to each of the isolated cross-sections to identify those cross-sections in which the interproximal surface of the tooth is not obscured by gum tissue.

139. The program of claim 138, wherein the computer, in applying the test to each of the isolated cross-sections, calculates the rate of curvature of the contour line.

140. The program of claim 138, wherein the computer, in identifying the initial 2D cross-section, selects as the initial 2D cross-section the isolated cross-section that lies closest to

the roots of the tooth and in which the interproximal surface of the tooth is not obscured by gum tissue.

141. The program of claim 127, wherein the computer, in applying the test, identifies two elements of the data set that define endpoints of a line segment spanning the relative minimum width of the initial 2D cross-section.

142. The program of claim 141, wherein the computer, in applying the test, defines for each endpoint a neighborhood containing a predetermined number of elements of the data set near the endpoint in the initial 2D cross-section.

143. The program of claim 142, wherein the computer, in applying the test, identifies an additional 2D cross-section of the individual component in a plane parallel and adjacent to the initial 2D cross-section, where the additional 2D cross-section also has a continuous, latitudinal width with a relative minimum value occurring at one end of the cross-section.

144. The program of claim 143, wherein the computer, in applying the test, identifies two elements of the data set that define endpoints of a line segment spanning the relative minimum width of the additional 2D cross-section by:

(a) defining two neighborhoods of data elements, each containing elements of the data set that are adjacent to the data elements contained in the neighborhoods defined for the initial 2D cross-section; and

(b) identifying one data element in each neighborhood that corresponds to one of the endpoints of the line segment spanning the relative minimum width of the additional 2D cross-section.

145. The program of claim 144, wherein the computer also establishes a solid surface that is fitted among line segments spanning the relative minimum widths of the parallel 2D cross-sections.

146. The program of claim 145, wherein the individual component to be modeled is a tooth and the solid surface represents an interproximal surface of the tooth.

147. A computer program, stored on a tangible storage medium, for use in creating a digital model of tooth in a patient's dentition, the program including executable instructions that, when executed by a computer, cause the computer to:

(a) receive a three-dimensional (3D) data set representing the patient's dentition;

(b) apply a test to identify data elements that represent an interproximal margin between two teeth in the dentition;

(c) apply another test to select data elements that lie on one side of the interproximal margin for inclusion in the digital model.

148. The program of claim 147, wherein the computer creates a set of 2D planes that intersect the dentition roughly perpendicular to an occlusal plane of the dentition, each 2D plane including data elements that form a 2D cross-section of the dentition.

149. The program of claim 148, wherein the computer identifies the 2D plane with the smallest cross-sectional area.

150. The program of claim 149, wherein the computer rotates the 2D plane with the smallest cross-sectional area to at least one other orientation to form at least one other 2D cross-section of the dentition.

151. The program of claim 150, wherein the computer selects the orientation that gives the rotated plane its smallest possible cross-sectional area.

152. The program of claim 151, wherein the computer identifies data elements that represent the selected orientation of the rotated plane as lying on an interproximal margin.

153. The program of claim 150, wherein the computer rotates the plane about two orthogonal lines passing through its center point.

154. The program of claim 149, wherein the computer creates a set of additional 2D planes in the vicinity of the 2D plane with the smallest cross-sectional area.

155. The program of claim 154, wherein the computer identifies the plane in the set of additional planes that has the smallest cross-sectional area.

156. The program of claim 155, wherein the computer rotates the plane with the smallest cross-sectional area to at least one other orientation to form at least one other 2D cross-section of the dentition.

157. The program of claim 156, wherein the computer selects the orientation that produces the 2D cross-section with the smallest possible area.

158. The program of claim 148, wherein the computer, in creating the set of 2D planes, creates an initial plane near one end of the dentition.

159. The program of claim 158, wherein the computer selects a point in the dentition that is a predetermined distance from the initial plane and creates a second plane that includes the selected point.

160. The program of claim 159, wherein the second plane is roughly parallel to the initial plane.

161. The program of claim 159, wherein the computer rotates the second plane to at least one additional orientation to form at least one additional 2D cross-section of the dentition.

162. The program of claim 161, wherein the computer selects the orientation that produces the 2D cross-section with the smallest cross-sectional area.

163. The program of claim 161, wherein the computer selects a point that is a predetermined distance from the second plane and creates a third plane that includes the selected point.

164. The program of claim 163, wherein the computer rotates the third plane to at least one other orientation to create at least one additional 2D cross-section of the dentition.

165. The program of claim 163, wherein the computer creates additional planes, each including a point that is a predetermined distance from a preceding plane, until the other end of the dentition is reached.

166. The program of claim 165, wherein the computer identifies at least one plane having a local minimum in cross-sectional area.

167. The program of claim 165, wherein the computer identifies a centerpoint of the cross-section in each of the planes and creates a curve that fits among the identified centerpoints.

168. The program of claim 167, wherein the computer creates a set of additional 2D planes along the curve, where the curve is roughly normal to each of the additional planes, and where each of the additional planes is roughly perpendicular to the occlusal plane.

169. The program of claim 168, wherein the computer identifies at least one of the additional planes that has a local minimum in cross-sectional area.

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170. A computer program, stored on a tangible storage medium, for use in creating a digital model of a tooth in a patient's dentition, the program including executable instructions that, when executed by a computer, cause the computer to:

(a) receive a 3D data set representing at least a portion of the patient's dentition, including at least a portion of a tooth and gum tissue surrounding the tooth;

(b) apply a test to identify data elements lying on a gingival boundary that occurs where the tooth and the gum tissue meet; and

(c) apply a test to the data elements lying on the boundary to identify other data elements representing portions of the tooth.

171. The program of claim 170, wherein the computer, in applying the test to identify data elements on the gingival boundary, creates an initial 2D plane that intersects the dentition roughly perpendicular to an occlusal plane of the dentition and that includes data elements representing an initial cross-sectional surface of the dentition.

172. The program of claim 171, wherein the computer locates a cusp in the initial cross-sectional surface.

173. The program of claim 172, wherein the computer, in locating the cusp, calculates rate of curvature of the initial cross-sectional area at selected points on the cross-sectional surface.

174. The program of claim 173, wherein the computer, in locating the cusp, identifies the point at which the rate of curvature is greatest.

175. The program of claim 172, wherein the computer creates a second 2D plane that is roughly parallel to the initial 2D plane and that includes data elements representing a second cross-sectional surface of the dentition.

176. The program of claim 175, wherein the computer locates a cusp in the second cross-

sectional surface.

177. The program of claim 176, wherein the computer, in locating the cusp in the second cross-sectional surface, defines a neighborhood of data elements around the cusp in the initial cross-sectional surface and projects the neighborhood onto the second cross-sectional surface.

178. The program of claim 177, wherein the computer, in locating the cusp in the second cross-sectional surface, searches for the cusp only within the neighborhood projected onto the second cross-sectional surface.

179. The program of claim 171, wherein the computer locates two cusps in the initial cross-sectional surface.

180. The program of claim 179, wherein the computer creates a second 2D plane that is roughly parallel to the initial 2D plane and that includes data elements representing a second cross-sectional surface of the dentition.

181. The program of claim 180, wherein the computer locates two cusps in the second cross-sectional surface.

182. The program of claim 181, wherein the computer, in locating the cusps in the second cross-sectional surface, defines two neighborhoods of data elements around the two cusps in the initial cross-sectional surface and projects the neighborhoods onto the second cross-sectional surface.

183. The program of claim 182, wherein each neighborhood projected onto the second cross-sectional surface includes data elements representing portions of the tooth and data elements representing the gum tissue surrounding the tooth.

184. The program of claim 183, wherein the data elements representing the tooth include voxels of one color and the data elements representing the gum tissue include voxels of another color.

185. The program of claim 183, wherein the computer, in locating the cusps in the second cross-sectional surface, locates the pair of data elements representing gum tissue that lie closest together, where each of the two neighborhoods projected onto the second cross-sectional surface includes one of the data elements in the pair.

186. The program of claim 170, wherein the computer, in applying the test to identify data elements on the gingival boundary, creates a series of roughly parallel 2D planes, each intersecting the dentition roughly perpendicular to an occlusal plane of the dentition, and each including data elements that represent a cross-sectional surface of the dentition.

187. The program of claim 186, wherein the cross-sectional surface in each 2D plane includes two cusps that roughly identify the locations of the gingival boundary.

188. The program of claim 187, wherein the computer identifies the cusps in each cross-sectional surface.

189. The program of claim 188, wherein the computer, in identifying the cusps, locates the cusps in one of the planes and then confines the search for cusps in an adjacent plane to a predetermined area in the vicinity of the identified cusps.

190. The program of claim 187, wherein the computer allows a human user to select data elements that roughly identify the locations of the cusps in a selected one of the cross-sectional areas.

191. The program of claim 188, wherein the computer searches for cusps in the selected cross-sectional area and confines the search to data elements lying within a predetermined area in the vicinity of the data elements selected by the human user.

192. The program of claim 188, wherein the computer searches for cusps in an adjacent cross-sectional area and confines the search to data elements lying within a predetermined area in the vicinity of the data elements selected by the human user.